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# STRATEGIC TARGET PLANNING

Bridging the Gap  
between  
Theory and Practice

RICHARD LEE WALKER

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# STRATEGIC TARGET PLANNING

## Bridging the Gap between Theory and Practice

by

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Senior Research Fellow

*by R. L. Walker, USAF*  
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## FOREWORD

In seeking a more flexible nuclear strategy, national policymakers may not be taking into account technical limitations to strategic target planning. This doubt is the driving concern behind the following study, by Colonel Richard Lee Walker, USAF. The study suggests that, because of recent changes in our nuclear strategy, the nuclear arsenal, and the enemy target system, a gap may have developed between strategic targeting theory and practice.

Colonel Walker traces the evolution of nuclear targeting, then turns to ways of dealing with the technical constraints faced by target planners. His foremost concern is that strategic targeting concepts do not exceed our technical ability to implement. The author proposes improvements in our strategic forces' command, control, and communications facilities to better ensure rapid retargeting. He also argues for more reliable and detailed target intelligence. Finally, Colonel Walker recommends that a special coordination committee be created to oversee new targeting initiatives.

As Colonel Walker reminds us, strategy designed in ignorance of real limitations is likely to fail—sober advice that all defense planners might take to heart. The National Defense University is pleased to bring this important analysis to the attention of the national security community.



**RICHARD D. LAWRENCE**  
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## **ABOUT THE AUTHOR**

Colonel Richard L. Walker, USAF, wrote this study while assigned as a Research Fellow at the National Defense University. Colonel Walker also served in the Strategic Air Command before assuming his current position with the Defense Nuclear Agency, Alexandria, Virginia. He received his B.S. degree in physics and M.S. degree in nuclear engineering at Michigan Technological University and a Ph. D. in applied science from the University of California. He was a physics instructor at Michigan Technological University and attended the Air War College. Other assignments include staff scientist for the Joint Strategic Target Staff at Offutt Air Force Base and nuclear research officer for the Air Force Weapons Laboratory at Kirtland Air Force Base.



## **PREFACE**

I have attempted to write this monograph for a broad audience, not just the policymakers, planners, and analysts familiar with strategic target planning, but also those individuals who have only a general background in national security. Attaining this goal has been difficult and further compounded by the security classification of the details on the subject.

This monograph introduces a potential problem and suggests improvements to help deal with it. A longer, identically titled classified version provides more background on problems within strategic target planning. The classified version reviews the principal elements of the strategic target planning process, identifies fundamental parameters, and examines practical considerations which limit flexibility. Access to this version can be arranged through the National Defense University Classified Library (AUTOVON 223-8168 or commercial 202-693-8168).

I began this work while assigned to the Joint Strategic Target Planning Staff. Admittedly, this monograph is biased by my experience as one of the "mechanics" in the bowels of the "underground" at Offutt Air Force Base; indeed, I dedicate it to those who served there—all good "moleholers," tried and true. I need add only one fraternal note: God bless the average, but don't forget Nagasaki.

I am indebted to the National Defense University for the opportunity to write this monograph. I especially appreciate the assistance and guidance provided by Colonels Frank Margiotta and Fred Kiley. Colonels Ted Crampton and Jay Kelley and Captain John McLaurin suggested changes that

materially improved the product. Leon Sloss provided a contrasting viewpoint which served to temper my observations. George Maerz is to be credited for his skill and dedication in editing the work. The degree to which this monograph is useful is clearly a measure of their contributions. The extent to which it is not is mine alone.

**RICHARD LEE WALKER**

## THE EMERGING PROBLEM

The United States' nuclear strategy has evolved from a premise of massive retaliation to one of assured destruction, and now to a more flexible targeting approach. This evolutionary trend resulted from the desire to provide the national command authorities (NCA) with rational alternatives for responding to possible attacks on the United States or its allies. As this concept of flexible response develops, an important question emerges: Are national policymakers taking into account the technical limits to flexibility in strategic target planning?

Notably, this is not a question of whether flexibility is needed. Secretary of Defense Harold Brown clearly stated the need in his last Department of Defense *Annual Report*:

Our planning must provide a continuum of options, ranging from use of small numbers of strategic and/or theater nuclear weapons aimed at narrowly defined targets, to employment of large portions of our nuclear forces against a broad spectrum of targets.<sup>1</sup>

What should be of concern is a question of technical considerations in strategic target planning which effectively limit the flexibility in attack options. The technical considerations in question arise when the strategic target planner assigns weapons against targets. Weapon system characteristics are used to evaluate the ability of a particular weapon to inflict the desired level of damage against a particular target. These characteristics either separately or jointly are the technical

considerations which largely determine the expected outcome of a planned attack.

If the desired level of damage cannot be achieved in any particular matchup, a different weapon system is tried. If no existing weapon system is capable of meeting the targeting objective, a new weapon system must be developed. Alternatively, the damage criteria for the target in question could be modified. Even then, certain technical considerations are inherent to the planning approach itself. In any case, until the deficiencies are resolved, the targeting objective of the attack is not satisfied and the strategy behind the attack is limited to some degree.

The technical considerations question is deliberately limited to strategic target *planning*; the *execution* of attack options by the strategic forces is not directly treated. However, it is recognized that the strategy of flexible response requires both nuclear forces and communications, command, and control and intelligence (C<sup>3</sup>I) resources capable of surviving in a protracted war.

The technical considerations question has no simple answer because the relevance of the concerns expressed in this monograph can be determined only by those who possess the proper "need to know" for the necessary classified information. Nonetheless, should the answer be negative, technical limits are not being taken into account, the objective of providing rational alternatives to the NCA under the guise of flexible response may be undermined by attack options in which specific goals are illusory or attainable only in theory.

If, indeed, oversight is the case, then the question becomes a critical problem requiring the immediate attention of national policymakers. Strategy designed in ignorance of real limitations is likely to fail. Planning objectives may not be met if specific goals are not achieved or if certain bounds are exceeded. The escalation control aspect of flexible response can be greatly disrupted by situations in which the results of a particular option are considerably different from what was expected. Unexpected outcomes in initial options can erode the

utility of or even preclude subsequent options. Additionally, attempts to compensate for shortfalls in goal attainment by increased weapon employment fail to recognize the source of the problem and will lead to inefficient use of the strategic arsenal.

Perhaps limitations are being considered in the formulation of the strategy of flexible response. Even so, it may be possible to increase the degree of flexibility in strategic target planning by applying the recommendations of chapter 4. The question deserves attention, whether it points us toward a critical problem or merely an area of possible improvement.

### **WHY DID THE QUESTION ARISE?**

The question of technical considerations limitations has emerged at this time because of recent changes in our nuclear strategy, our nuclear arsenal, and the enemy target system. These changes reflect the maturity of the nuclear age and the attempts of the superpowers to come to grips with the reality of national security requirements in the face of potential nuclear holocaust.

#### **Nuclear Strategy**

In the immediate postwar period when the United States had a monopoly on nuclear weapons, the national strategy was one of massive retaliation. The Truman containment doctrine to halt the spread of communism focused on the threat of Soviet aggression in Europe. The establishment of NATO in 1949 was designed to counter that threat. Massive retaliation against Soviet cities by the United States nuclear arsenal underwrote the treaty's commitment to defend Europe. Strategic targeting was viewed as a simple extension of the World War II concepts, only with a more powerful weapon. Nuclear attacks were planned against industrial facilities, transportation links, and long-range aviation.

During the Eisenhower administration, the nuclear strategy took on a new look. The Soviet Union had broken the US

monopoly on atomic weapons and proceeded to the thermonuclear age by detonating its own hydrogen bomb. The United States responded with an increase in its nuclear arsenal and an emphasis on airpower to provide strategic deterrence. The advent of tactical nuclear weapons spawned by the new thermonuclear technology led to another significant change in policy. NATO conventional force goals were reduced in favor of tactical nuclear weapons.<sup>2</sup>

In the 1950s, the strategic balance between the United States and the Soviet Union was commonly believed to be inherently stable. At the time, a popular image of the nuclear powers was one of two scorpions trapped in a bottle. Neither could sting the other to death without being killed in return. This view was challenged in 1959 when Albert Wohlstetter pointed out the possibility of a disarming "counterforce" first strike against nuclear delivery systems.<sup>3</sup> He maintained that it was essential to develop well-protected second-strike forces which could survive a first strike and retaliate. So by the close of the decade, the concept of a second strike posture was at hand.

Flexible response was introduced in the Kennedy administration by Secretary of Defense Robert McNamara to provide an alternative to the spasm response of massive retaliation. During the 1960 Presidential campaign, as a candidate John Kennedy took the position that conventional forces needed to be bolstered to meet Soviet aggression without resort to nuclear weapons. However, after the election as the new administration studied the situation in Europe, it became apparent (for both practical and political reasons) that reliance on nuclear weapons could not be eliminated. At the strategic level, Secretary McNamara perceived the need to develop second-strike options that were appropriate responses to potential Soviet first strikes. As a result, the US strategy was changed to include options that clearly distinguished between attacks on military targets and attacks on cities. The separation of counterforce and "countervalue" attacks set the stage for the damage-limiting concept.

The damage-limiting concept advanced by Secretary McNamara included a counterforce attack against the Soviet nuclear threat, employment of an antiballistic missile defense, and a passive civil defense. The objective of counterforce attack would be twofold: to signal the Soviets that their cities, though not attacked, were still at risk and to destroy the Soviet nuclear threat to the US and its allies.<sup>4</sup> However, it became apparent that practical damage limiting was both too costly and politically unsatisfactory. By 1965, the damage-limiting concept was set aside in favor of the deterrent value of assured destruction.

Assured destruction became the central feature of the US second strike posture in the late 1960s and early 1970s. Secretary McNamara considered assured destruction the ability to inflict unacceptable damage upon an aggressor under any situation of nuclear war, including a surprise first strike.<sup>5</sup> This assured destruction posture was not a return to the spasm war concept. The wider range of options, including the damage-limiting counterforce attack, was retained in the operational plans. However, the ultimate countervalue attack was the kingpin of the nuclear deterrence and served as the measure of the adequacy of the strategic force structure. As a result, damage-limiting capabilities were not deliberately designed into the force, but were acquired as a bonus in large measure due to conservative assumptions used in planning strategic force levels.

The doctrine of strategic sufficiency was introduced in 1970 by President Richard Nixon.<sup>6</sup> It was not a major shift in policy. The doctrine rejected spasm retaliatory attacks against population; it subscribed to controlled response to deter limited nuclear attacks; it endorsed the assured-destruction second-strike posture; it also disavowed any attempt to achieve a first-strike capability by either side. While the strategy of flexible response continued in the doctrine of strategic sufficiency, the options available to the NCA were essentially those first established by Secretary McNamara. It was not until 1974 under the direction of Secretary of Defense James

Schlesinger that any substantial increase in flexibility was actually implemented in operational planning.

Secretary Schlesinger pointed out that deterrence based upon mutual assured destruction could fail. Large-scale retaliatory attacks upon the Soviet Union, in response to a limited nuclear strike on the United States, were not a credible option:

What we need is a series of measured responses to aggression which bear some relation to the provocation, have prospects of terminating hostilities before general nuclear war breaks out, and leave some possibility for restoring deterrence. It has been this problem of not having sufficient options between massive response and doing nothing, as the Soviets built up their strategic forces, that has prompted the President's concerns and those of our Allies.<sup>7</sup>

The change in targeting doctrine implemented by Secretary Schlesinger was designed to "shore up deterrence across the entire spectrum of risk." Flexibility and selectivity were the key goals emphasized in the change. More-selective options, relatively small scale, were added to the existing large-scale options to achieve these goals. The new options were designed to minimize unintended collateral damage (e.g., civilian casualties). While these options required forces with hard-target kill capability, any idea of acquiring a first-strike posture was totally rejected. Even though attention was focused on limited nuclear attacks, the assured destruction concept of countervalue retaliation remained the cornerstone of deterrence. The capability to "withhold an assured-destruction reserve for an extended period of time" was the principal member of the deterrence framework being shored up.

When President Jimmy Carter took office, he ordered a review of the nuclear targeting policy. The review, known as Presidential Directive (PD) 18, endorsed the Schlesinger initiatives but called for further study of the employment policy. As that study proceeded, Secretary Brown expressed concern with the continued military buildup of the Soviet Union and advanced the concept of a "countervailing" strategy to deal with



the growing threat. His countervailing strategy amounted to a victory-denial policy:

We must have forces and plans for the use of our strategic nuclear forces such that in considering aggression against our interests, our adversary would recognize that no plausible outcome would represent a success—on any rational definition of success.<sup>8</sup>

The study of the employment policy, specifically the "plans for the use of our strategic nuclear forces," culminated in PD-59. After PD-59 was announced by the Carter administration, the press labeled it a "new strategy" and reported it as a shift of emphasis in nuclear policy from deterrence based upon countervalue retaliation to deterrence based upon counterforce/countercontrol warfighting. Secretary Brown corrected the misunderstanding and misinterpretation of PD-59 in his last Department of Defense Annual Report.<sup>9</sup> According to Secretary Brown PD-59 essentially formalized the long-developing shift in nuclear policy toward more-flexible attack options. It established targeting objectives for selective attacks against Soviet military targets, Soviet military and political leadership, and the Soviet industrial and economic base. It also called for a secure strategic reserve to carry out the assured destruction role, if required.

At the time of this writing, the Reagan administration had not updated the position stated at the Republican Convention:

Our objective must be to assure the survivability of the US forces possessing an unquestioned, prompt, hard-target counterforce capability sufficient to disarm Soviet military targets in a second strike.<sup>10</sup>

The foregoing account of the changes in the nuclear strategy followed by the United States is summarized in table 1-1.

### **Nuclear Arsenal**

The strategic arsenal of nuclear warheads and weapon carriers also has undergone an evolutionary development.

**Table 1-1. Changes in Nuclear Strategy**

<b>Strategy/Phase</b>	<b>Time Span</b>	<b>Features</b>
<i>Massive Retaliation</i> Postwar Doctrine	1945-1952	Countervalue Attack Counterforce Attack
<i>New Look</i>	1953-1959	Countervalue Attack Counterforce Attack Tactical Nuclear Weapons
<i>Flexible Response</i> Damage Limiting/Assured Destruction	1960-1965	Countervalue Attack Counterforce Attack Tactical Nuclear Weapons Damage Limiting
Mutual Assured Destruction	1966-1973	Countervalue Attack Counterforce Attack Tactical Nuclear Weapons
Selective Targeting/Assured Destruction	1974-	Countervalue Attack Counterforce Attack Tactical Nuclear Weapons Escalation Control

The means of delivering a strategic nuclear attack grew from a few aircraft-delivered warheads to the current triad of strategic weapon systems. Technological innovation, emerging threats, and parochial service interests were as important as strategic thought in bringing about the changes.

In the immediate post-World War II period, the airpower that carried out the strategic bombing during the war was assumed to be the proper choice for the nuclear arsenal. This belief continued through the early 1950s when the Eisenhower administration felt that the technology represented in the superior airpower of the United States could offset the manpower of the Soviet Union.<sup>11</sup> The airpower arsenal grew to about 2,000 weapon carriers, including bombers and guided missiles.

The development of low-weight, high-yield thermonuclear weapons coupled with the advent of intercontinental ballistic missile (ICBM) technology ended the dominance of the airpower arsenal. The possibility that the Soviets could destroy the relatively soft and slow-response systems in a surprise attack became an overpowering threat. In response to the so-called missile gap, the Air Force and the Navy competed to provide a survivable nuclear-strike force. Instead of selecting either the invisible sea-borne submarine-launched ballistic missile (SLBM) force or the protected land-based ICBM force to replace the vulnerable airpower arsenal, the Kennedy administration accelerated both the Polaris and Minuteman programs and raised the alert level of the long-range bomber force. The B-47 bombers and other medium-range forward-based systems, considered most vulnerable to Soviet pre-emptive attacks, were retired.<sup>12</sup> These changes converted the airpower arsenal into a triad force structure of ICBMs, SLBMs, and bombers.

The triad matured when multiple independently targetable reentry vehicle (MIRV) technology provided multiple-weapon carriers for all legs of the triad. The MIRV technology changed the strategic arsenal from one with warhead yields that were predominantly in the megaton range to one whose spectrum ranged from tens of kilotons to several megatons, with the lower yields predominating. Even though the arsenal was fractionated in yield, increased accuracy provided a better hard-target kill capability. By 1975 the ICBM component of the triad consisted of 550 Minuteman IIIs, each with 3 MIRVs; 450

single-warhead Minuteman IIs; and 54 single-warhead Titan IIs. In 1976, the SLBM component consisted of 496 Poseidon missiles, each with 10 to 14 MIRVs, in 31 submarines and 160 Polaris missiles in 10 submarines. During this period, the aircraft leg of the triad was decreasing from over 500 to fewer than 450 long-range bombers (B-52s and FB-111s).

In 1979, Under Secretary of Defense for Research and Engineering William Perry described the extent of force modernization required to support Secretary Brown's countervailing strategy:

To implement that strategy we need forces that, first of all, can survive, even after a very well-executed surprise attack . . . Second—besides survivability—our forces need to be able to react with whatever flexibility is required by the National Command Authorities. . . . The third point is that the forces need to be capable of penetrating whatever defenses the Soviet Union may have. Fourth, we must be able to destroy a fairly broad array of targets . . . It is not sufficient for our forces to survive if our command structure has been disabled. So in the force modernization program (are included) programs to increase survivability and endurance of the command and control systems that direct those forces.<sup>13</sup>

This call for survivable, responsive, and effective forces reflects the concern held by US policymakers with the ever-expanding Soviet threat. The burgeoning Soviet strategic capability has reached parity with that of the United States, and the beginning of an era of Soviet strategic nuclear weapons predominance is apparent.

### **Target System**

Since World War II, the target system of the US strategic arsenal has grown from a few Soviet cities to a broad and complex array of military and civil installations. In the era of the airpower arsenal, the target system expanded from the simple selection of Soviet cities for retaliatory strikes to the counterforce, countervalue target set of military bases, industrial facilities, and government centers. This increase in the

target system was influenced principally by the targeting doctrine of the Strategic Air Command.<sup>14</sup>

As the Soviets developed a credible nuclear threat to the US triad, Soviet weapons systems became high-priority targets. At first, these targets were relatively few, slow in execution, and "soft" to nuclear attack. However, as the Soviet Union fielded successive generations of ICBMs, it greatly increased the number and hardness of silos and launch control facilities. At the same time, the concept of limited nuclear operations dictated the selection of industrial facilities and military installations that could be struck without causing unwanted collateral damage. Besides the obvious selection of silos in missile fields, this remote target set included certain airfields, dams, submarine support facilities, and isolated industrial facilities.<sup>15</sup>

The size of the target system has grown considerably in terms of the numbers of installations contained in the data base itself. This increase is a reflection of the refinement in the targeting doctrine, real growth in the Soviet Union, and improved US intelligence collection. In 1974 the number of installations in the target system was more than 25,000.<sup>16</sup> In 1979 it was reported that the "annual average increase in the target list [was] approximately 10 percent over the past several years."<sup>17</sup>

Within this burgeoning target system, special target sets responsive to the selective targeting concept of the countervailing strategy were recently estimated to include

Leadership: about 700 underground shelters for key Soviet officials throughout the country. US planners believe they have located most of them.

Strategic targets: about 2,000, including 1,400 ICBM silos, plus command and control bunkers, nuclear storage sites, and strategic air and naval facilities.

Other military targets: about 3,000, including 500 airfields, plus military units, supply depots and critical transportation hubs.

Key factories: between 200 and 400.<sup>18</sup>

These installations, of course, are a subset of the total target base defined by the assured destruction requirements of the US targeting doctrine.

The separate but interdependent evolutions of nuclear strategy, the strategic arsenal, and the target system set the stage for the emerging problem of real limitations to flexibility in strategic target planning. The nuclear strategy has become sophisticated in concept and complex in objectives. The strategic arsenal required to carry out or support the strategy is a triad of nuclear forces with varied-performance, multiple weapon-carrier systems. The target system is large numerically, dispersed geographically, and diverse categorically, but at the same time, a large fraction is collocated with urban areas and functionally interrelated. The technical considerations in the interaction between the target system and the weapon systems can effectively limit the achievement of the strategic objectives.

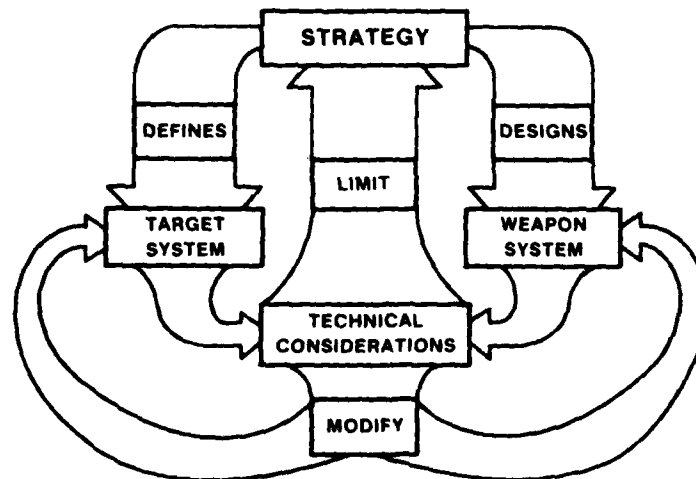
#### **WHERE DO LIMITATIONS APPEAR?**

The essence of strategic targeting is designing a plan that assigns weapons against targets to achieve the goals of strategy; the ultimate strategic targeting plan is the Single Integrated Operational Plan (SIOP) developed by the Joint Strategic Target Planning Staff (JSTPS). The SIOP is the capabilities plan that integrates and coordinates the strategic forces assigned to strike various aim-points in the enemy target system for the various preplanned attack options designed to support and carry out national strategy. This plan, based on the capabilities of forces in being, is the a priori measure of the United States' ability to execute its strategic policy.<sup>19</sup>

Strategic target planning, then, is the means by which the nuclear strategy is implemented. In theory, the strategy should define the target system and determine the design of the weapon systems. Strategic target planning, in this case, is the straightforward process of taking into account the technical

considerations involved in assigning the weapons against targets. The considerations reflect shortcomings in matching the existing strategic arsenal against the enemy target system across a continuum of attack options. Those shortcomings which are directly related to weapon characteristics (e.g., warhead yield or weapon accuracy) can be resolved by improved weapon design. Those due principally to target characteristics (e.g., time sensitivity or mobility) are more difficult to deal with.

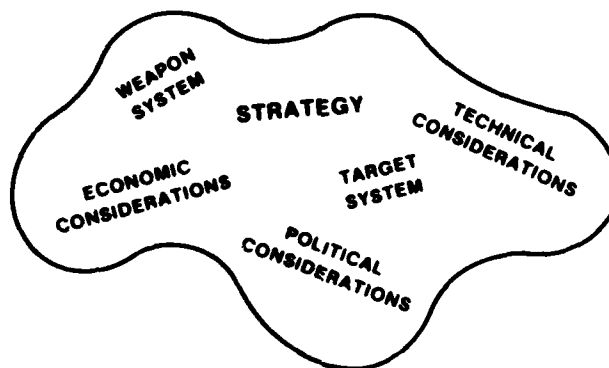
Ideally, as the shortcomings are identified, action can be taken to modify either the target system or the weapon systems. When modifications to either the target system or the weapon systems fail to resolve a shortcoming, the strategy is effectively limited. A schematic of this simplified view of the functional relationships of strategy, weapons, and targets is presented in figure 1-1.



**Figure 1-1. Ideal Schematic for Strategic Target Planning Relationships**

In practice, the functional relationships in strategic target planning are not so clearly defined and are better represented

by the amorphous amalgam depicted in figure 1-2. Despite grand pronouncements by NCA spokesmen, it is not clear that strategy is always the driving element. Often political and economic considerations become paramount, particularly when aspects of broad national policy are operative. These nontechnical considerations played important roles in the evolution of the nuclear strategy described earlier. Economic considerations affect the weapon systems directly, whereas political considerations can influence both target selection and weapon procurement.



**Figure 1-2. Strategic Target Planning Relationships—Realistic View**

Since the realistic view of the overall situation is unclear, a narrower view focused on the quantitative aspects of strategic target planning is in order. These quantitative aspects of strategic target planning differ according to the particular analytical framework used. The mathematical structure employed can vary from simple to complex, depending upon the type of strategic analysis being conducted. Regardless of the complexity involved, the analysis process has three steps: input, methodology, and output.

Three modes of strategic analysis are commonly used: theoretical comparison, gaming and simulation, and practical



estimates. These three modes of strategic analysis are compared in terms of their process steps in table 1-2.

**Table 1-2. Strategic Analysis Process**

Mode	Input*	Methodology	Output
Theoretical Comparison	Guidance Weapons Targets	Figures of Merit	Strategic Balance
Gaming/Simulation		Aggregate Modeling	Net Assessment or Force Structuring
Practical Estimate		Detailed Treatment	Operational Planning

\*All three modes use the same input categories (guidance, weapons, and targets), but each requires different levels of detail in the data.

Theoretical comparisons are made using figures of merit to calculate static measures of effectiveness. An example is the use of equivalent megatonnage as a measure of the strategic balance between the nuclear arsenals of the United States and the Soviet Union. In this case, the input is simply the yield of the weapons in both arsenals. The mere selection of equivalent megatonnage as the figure of merit precludes any guidance or target inputs required by other measures. This particular figure of merit methodology compares the capabilities of various nuclear weapons by the area exposed to a given blast overpressure. The output establishes the relative, theoretical effectiveness of different nuclear arsenals against hypothetical, pressure-sensitive area targets. Al-

though often misused, the figure of merit is a popular measure of the strategic balance between two nuclear arsenals.

Analyses in the gaming and simulation mode are typically based upon computer programs that employ aggregated modeling. In this context, aggregated modeling is the simulation of a process or system by a formulation which does not treat all factors involved. Instead, the contribution of some factor is represented by assumed or empirically derived dependent functions or ignored altogether. The degree of aggregation can range from gross approximations to sophisticated constructs. In the aggregated mode, the inputs generally include specific data on weapons and targets and broad targeting objectives from the guidance. The output is typically a parametric analysis, such as a net assessment or a force structuring study.

Practical estimates rely on detailed treatment of all factors required for operational planning. The analysis is as "real world" as possible, given the uncertainties and unknowns involved, but remains, despite exhaustive calculations involving a myriad of factors, only an expected-outcome estimate. This mean-value, detailed-treatment methodology is the mathematical foundation of the nation's general nuclear war plan, the SIOP.

In practice the three modes are not always used as separate and unique approaches. Figures of merit are used in all modes, both for convenience and out of necessity. A certain amount of aggregated modeling must be used in the practical estimate because the real world is sometimes incalculable. As a result, strategic analyses are more often a continuum of the modes rather than discrete bands. Nevertheless, a distinction can be made among the modes, and more importantly, the suitability of the methodology used should be considered when evaluating the results of an analysis.

The basic limitations in strategic target planning—generally ignored in theoretical comparisons and seldom treated in gaming and simulation, particularly for highly aggregated models—manifest themselves directly in the detailed treat-

ment of the SIOP. The public debate on nuclear strategy, arms control, and force structure has relied almost exclusively on the theoretical comparison mode for quantitative analysis. Policymakers presumably have numerous gaming and simulation routines available to them. However, the credibility and effectiveness of strategy must be shown at all levels of analysis. Thus the question remains: Are the policymakers who are responsible for developing and refining strategy aware of basic limitations that become fully apparent only in the practical-estimate mode of strategic analysis?

## BRIDGING THE GAP

The SIOP development process uses an expected-value, detailed-treatment approach to convert rather diverse, dynamic inputs into a relatively stable plan. The expected-value methodology is the bridge the planner relies on to cross the gap between predicted and real events. Because real forces and targets are involved, the planner cannot assume away problems, but must deal with all pertinent operational details. In order to provide high assurance of mission accomplishment, the current plan must remain as static as possible. These aspects of the planning approach impose unique limits on flexibility.

### EXPECTED-VALUE METHODOLOGY

Expected-value planning is viable when large numbers of events are involved. However, even with large numbers the actual outcome can be considerably changed in details. Strategic target planning is based on mean-value estimators of the contributing factors. These estimators may actually be the mean value of operational test measurements or only the best estimate derivable from empirical modeling or theoretical calculations.<sup>1</sup> They represent the "on the average" values assigned to the contributing factors. Should the SIOP or some portion of it be executed, the actual value for each individual factor would most likely not be the average value used in the plan. But this is not cause for alarm, because the large number of events involved tend to wash out or compensate for individual extreme-value outcomes.

The single-value, expected-outcome approach becomes questionable when applied in a scenario bounded by a limited number of events (unless that scenario is repeated a large number of times). For a nuclear age example there is only one actual case in point: the atomic bombing of Hiroshima and Nagasaki illustrates the potential difference between expected outcomes and real events. The point of interest is the contrast between what was planned and what actually happened.

The directive ordering the atomic bomb attack on Japan identified Hiroshima, Kokura, Niigata, and Nagasaki as targets for the special bomb. Nagasaki held the lowest priority; it had unfavorable terrain. The attack was to be carried out as soon as weather conditions permitted visual bombing.<sup>2</sup> The first attack unfolded according to the plan. The flight from Tinian was uneventful; the weather at Hiroshima presented no problem for visual bombing; and the actual ground zero below the airburst was only a few hundred feet away from the aim-point.

The second attack courted failure from start to finish. Weather en route was poor, and after the strike force had waited for an observation plane which never made the rendezvous, the weather at the primary target, Kokura, closed in. The strike force made three runs on Kokura without sighting the target and, with gas running too low to reach Niigata, departed for Nagasaki. One run was made (90 percent by radar) against Nagasaki, and the bomb was dropped through a "hole" in the 8/10 cloud cover. According to conflicting records, the ground zero was either several thousand feet or more than a mile and a half from the intended aim-point. The plane which dropped the bomb had to divert to Okinawa to make an emergency landing with only a few gallons of fuel left.<sup>3</sup> In both cases, the mission was completed and the target objective was, apparently, met. However, the corresponding preplanned phases of the two missions had dissimilar outcomes.

The expected-value approach employed in the SIOP development process implies that uncertainty bounds can be established for the probable outcome of an attack option. This is

true only to the extent that all of the mean-value inputs are valid estimators of the probability distributions for their respective events or contributing factors. For instance, it is certainly true in those cases that have the estimator as a pure statistic of the parent population, the census of which catalogs all possible outcomes of an event or values of a contributing factor. Mean-value inputs derived from operational test data fall in this category, with the caveat that such testing may not reflect actual wartime employment conditions.

The data sample used to generate the mean value can also establish the variance of that statistic and, in turn, its associated confidence intervals or uncertainty bounds.<sup>4</sup> On the other hand, best estimates stemming from modeling and theory cannot be considered as pure statistics. Nevertheless, uncertainty bounds could be established in the same manner that the best estimate itself was obtained. However, such bounds tend to reveal more about the validity of the approach used to obtain the estimate than about the actual uncertainty in the factor itself.

Even if the variances of the factors were known or could be credibly estimated, it may still not be possible or practical to determine the uncertainty bounds on the outcome of an attack option. For a mathematical modeling process, two methods of assessing the impact of input data uncertainties on output are available: error propagation analysis and Monte Carlo simulation. In essence the first method is the tracking of the propagation of errors through the various computations of the process and the estimating of the variance in the output. This technique relies on first-order approximations of the propagated errors using derivatives of the governing equations in the process.<sup>5</sup> The second method simulates the effects of uncertainties in input data by generating a large number of random values for each input.

Both approaches assume no correlation among the input data. (Such an assumption may be wrong for calculations in-

volving common carriers with system biases.) Error propagation analysis requires that all mathematical expressions be differentiable, that the variances be relatively small, and that the variances be based on normal probability distributions. Modifications have been made for cases where derivatives cannot be evaluated and the variances are large.<sup>6</sup> Monte Carlo simulations are generally limited only by the cost and time required to generate sufficient statistical results. For large attack options, full treatment by the Monte Carlo method is not practical.

### DETAILED TREATMENT

The detailed-treatment character of the SIOP development process imposes a practical burden on JSTPS simply from the vast number of calculations required. This is not a case in which some software package can make myriad calculations and come up with a final number or set of numbers. As pointed out before, the JSTPS analyst works in a manual, computer-assisted mode to make decisions on discrete weapon-target matchups. The computer system is operated principally as an information management tool; the analyst acts out a role as the "man-in-the-process."

Over the years since JSTPS was established, both the target system and the weapon arsenal have increased in number. These increases translate into an exponential increase in the potential calculations required. As increased flexibility is introduced, the burden increases at least in a linear fashion. An attack option significantly different from existing options could add a new dimension contributing to the exponential growth of the necessary calculations. Even so, the man-in-the-process approach cannot be sacrificed to meet rising calculational demands. An attempt to replace the analyst with a programmed decisionmaking "black box" is not an acceptable solution. There are two fundamental reasons for this assertion: quality control and data filters.

As one of the most comprehensive, complex plans in the military community, the SIOP presents a strong quality-control challenge. The SIOP development process is extremely involved and requires many discrete, unique decisions that often rely on military judgment. Enough opportunities must exist throughout the process for the analyst to exercise quality control. Ordinarily this control is best accomplished when focused on the interim products of the process, such as the target base, the desired ground zero system, and defense emergency goals. Quality-control points must be established to serve as "windows in the pipeline" through which the analyst can observe the plan as it takes shape.

The SIOP development process must be responsive to dynamic inputs, but at the same time it must provide a relatively stable output. The SIOP is, after all, a set of preplanned options for employment of the strategic triad. Although Minuteman III has a rapid retargeting capability, the other weapon systems in the triad are less responsive. Additionally, the retargeting of one weapon system may affect other systems which are unable to change. As new data enter the development process, they must be closely monitored to limit any detrimental impact on the current plan in the field. Analysts accomplish this by filtering out new input data at critical points in the process to maintain stability in the operational commands. Obviously, the filtering is strong for the current revision, limited for the planning revision, and not needed for the future revision. Fortunately, the filter points typically coincide with the quality-control windows in the development process.

The foregoing practical considerations and the current planning approach impose basic limitations on the degree of flexibility attainable in strategic target planning. Although there are other impediments to flexibility, these limitations do highlight the gap between theory and practice in strategic target planning.



## POSSIBLE IMPROVEMENTS

The countervailing strategy promulgated by PD-59 is assumed to be the proper national policy for the United States. Given this assumption improvements are suggested in this chapter and are intentionally limited to the mechanics of implementing strategy rather than the strategy itself. Debate over this policy issue is expected to continue as proponents and opponents exchange views.<sup>1</sup> Nonetheless, the basic limitations exist now and should not be ignored.

### POLICY FORMULATION

Policymakers responsible for developing and refining strategy should be aware of the basic limitations in strategic target planning, but being aware is only part of the problem at hand. More important is how to deal with the basic limitations in policy formulation.

#### Concept Development

Because the limitations manifest themselves completely only in the detailed-treatment methodology of strategic analysis, new concepts of targeting should be examined in that mode. Figures of merit and aggregate-modeling methodologies provide inadequate testing of the credibility and effectiveness of new targeting concepts. Policymakers should subject new concepts to the most rigorous review possible. If a new concept is proposed for consideration as a SIOP option, it should be subjected to the detailed-treatment development process.

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More important, to obtain the maximum degree of flexibility in strategic targeting, policymakers should consider the full spectrum of attack options. It is not necessary or even desirable that the search for increased flexibility be limited to the SIOP. In addition, new concepts should not be forced into the SIOP structure if they degrade the integrity of the major attack options. Flexibility gained at the expense of deterrence is unacceptable. Flexibility which enhances deterrence across all levels of conflict is the goal.

New concepts should be studied closely to validate their viability in terms of targeting objectives and their feasibility in terms of the available technology and intelligence. Furthermore, the formulation of concepts should be open to all agencies involved in national security. An open forum with wide representation—the State Department, the National Security Council, the Central Intelligence Agency, and the Department of Defense—would be a guard against inadequacies, concepts “seriously deficient in the diplomatic, political, and economic fields.”<sup>2</sup> Such a forum could examine the targeting objectives from rather diverse viewpoints. The forum would also be well suited to make an initial examination of the concepts for potential technological barriers or intelligence shortfalls. Technological barriers arise when existing weapon systems are unable to meet targeting objectives without major design changes, large number increases, or radical employment tactics. Intelligence shortfalls become more evident as targeting objectives narrow down in scope and scale. If the initial examination should uncover barriers or shortfalls which thwart otherwise acceptable concepts, the forum could recommend actions to remove the obstacles.

#### **Weapon System Design**

Increased flexibility in the SIOP probably could be obtained by deploying weapon systems designed to minimize the basic limitations. However, the cost of tailoring the entire strategic arsenal to maximize flexibility is probably an unacceptable burden. Flexibility argues for a single-warhead carrier

with multiple-yield selection, rapid retargeting functions, a survivable basing mode, and a high-assurance penetration capability. The current arsenal is predominantly multiple-warhead carriers with few of the other attributes listed. The force modernization efforts underway continue to emphasize the multiple-warhead carrier, because it is a very cost-effective weapon system when viewed from the standpoint of the major attack options in the SIOP.

On the other hand, a portion of the strategic arsenal could be designed with flexibility in mind. One possibility is modernizing Minuteman II as a single, maneuverable reentry vehicle with a multiple yield warhead. The missile could be deployed in a proliferated, vertical-silo basing mode with a rapid retargeting capability. Alternatively, the MX force could have a small fraction of its boosters similarly equipped. Other variants on existing and proposed systems should be possible. Additionally, simple changes in employment doctrine can provide more of the desired attributes. For example, a cruise missile carrier (either a submarine or airborne alert aircraft) operating in the standoff mode (carrier not required to penetrate enemy defenses) would provide flexibility in a nontime-sensitive scenario.

However, the most critically deficient aspect of the US strategic posture is the C<sup>3</sup>I system. Already overstressed, the system appears inadequate for the evolving threat. The immediate problem is to deal with the fixed base, single-link warning network. In 1980, General Richard H. Ellis, the Commander in Chief, Strategic Air Command, commented on the problem:

An effective command, control and communications system must do two things. First, it must provide detailed, unambiguous warning and accurate attack assessment information, and, second, it must have an enduring capability for command control of forces worldwide through all phases of conflict. . . .

That threat [Soviet submarines operating off U.S. coasts] puts terrible stress on our national command and

control problem, and we need to get on with improving the survivability of the network faster than we are today.<sup>3</sup>

Providing flexibility to bolster deterrence is certainly important, but the inability to respond in a timely fashion renders flexibility meaningless to execution decisions if deterrence fails.

As critical as tactical warning may be, strategic warning has the potential for providing a significant force multiplier. But strategic warning needs to be improved to abet better understanding of specifically what needs are to be countervailed against. Space-based systems should be designed to provide real-time intelligence data. The ability to track mobile targets and monitor troop movements is indispensable for strategic warning. The need for improved strategic warning stems from not just a desire for more flexibility but the overall concern for national security. The ability to react to strategic warning with rapid retargeting provides the force multiplication needed to permit increased flexibility without excessive increases in the size of the strategic arsenal.

#### **Target Intelligence**

Target intelligence analysis will need to be carried out in greater detail to support the narrower targeting objectives associated with increased flexibilities. New targeting concepts should be thoroughly examined from the standpoint of the intelligence available on the pertinent installations in the target system. Any shortfalls identified must be remedied before the targeting concept is proposed for evaluation in the detailed-treatment methodology. As the targeting objectives become more sophisticated, more must be known about the interrelationship of the installations in the target set under attack. The required information would reveal not only how the set functioned as a subsystem, but also whether a complete set had been identified.

Additionally, the target set involved in any new concept should be closely examined to determine if unique damage criteria can be established. It may be consistent with the targeting objective simply to disrupt rather than destroy certain

functions of the target set. With an understanding of the interrelationship of the various installations, the targeting objective may be accomplished in a unique manner which could either reduce weapon requirements or enhance the damage provided by a fixed allocation of weapons.

The present damage assessment system is based on the target's susceptibility to nuclear blast damage. As the number of weapons or installations diminish in a particular option, more attention can be paid to other weapon effects in planning the attack. When avoidance of collateral damage is involved, this opportunity to examine other weapon effects becomes a mandatory task. It seems prudent that, as targeting objectives are narrowed down to fewer and fewer weapon-installation combinations, more intensive damage assessment calculations be undertaken. Such a course would be called for not just because it is affordable in terms of computations by planners, but because with fewer actual events the real outcome can be considerably different from the expected outcome. In addition, an understanding of the scope of the potential outcomes is essential in judging the efficacy of the attack.

### **STRATEGIC TARGET PLANNING**

Closing the gap between theory and practice in strategic target planning is a responsibility shared by both the policy-maker and the military planner. The responsibility for dealing with the basic limitations can be met by chartering a coordination committee and establishing procedures to handle all new targeting concepts. The committee could act as a clearing house for targeting initiatives, guide the concept definition and preliminary review, monitor the operational assessment of proposed attack options, and offer recommendations to the Secretary of Defense.

#### **Coordination Committee**

A special coordination committee could serve as the forum in which the merits of new targeting concepts are evalu-

ated and debated. This committee could serve to coordinate the activities required to evaluate the viability and acceptability of new concepts. A possible version would be chartered by the Office of the Secretary of Defense and have a membership representative of all agencies involved in national security.

The committee would be comprised of an executive group appointed by the Secretary of Defense and two subcommittees. The executive group would control the activities of the subcommittees and, with consent of OSD, would task elements of DOD for support. The subcommittees would separately evaluate the concepts for potential technological barriers and intelligence shortfalls, respectively; these evaluations would be the initial shakedown of any proposed targeting concept. As such, the subcommittees should enjoy open forum and wide-ranging debate (to the degree that classification permits) without bureaucratic censorship. To this end, the membership on the subcommittees must also be diverse and at the same time capable in the respective disciplines. A case in point, the accomplishments of the DOD-wide ad hoc group set up to formulate the policy leading to National Security Directive Memorandum 242 (a statement of nuclear policy) were attributed to the "thorough integration of all of the concerned people, both on the military side and on the civilian side, within the DOD as well as other important agencies."<sup>4</sup>

#### **Planning Procedure**

A three-step procedure consisting of concept definition, preliminary review, and operational assessment should be established for the coordinating committee to follow in carrying out its function. In the first step, the targeting objectives would be established and evaluated in terms of the desired impact on the enemy's values and perception. As part of this process, it would be essential to explore thoroughly the diplomatic, political, and economic aspects to assure a balanced examination of the concept. Thus, the first step should involve the entire committee membership with vigorous, unfettered discussions to foster as much innovative thinking as possible.

The second step, preliminary analysis, would use gaming or simulation analyses to determine if any technological barriers or intelligence shortfalls exist. In this step, the concept could be treated as an isolated attack to establish baseline force requirements. At this time, there would be an opportunity to explore alternatives by varying the target set covered, damage levels sought, force structure allocated, and the weapon tactics employed. Such an analysis would not be intended to produce the final design of the attack option, but rather to bound the problem in terms of barriers and shortfalls. If a problem were identified, the concept could be rejected or action could be recommended to deal with the barriers or shortfalls, as required.

The third step, operational assessment, would subject the new concept to the detailed-treatment methodology of strategic analysis. The objectives would be evaluation of the effectiveness of new concepts and determination of what attack level they are best suited for.

A convenient division of labor exists between the preliminary review and the operational assessment. The former, being broad in scope, should be accomplished by a team of policymakers from the Office of the Secretary of Defense, Office of the Joint Chiefs of Staff planners, service staff analysts, and other agency support personnel. The analytical tools employed could be the same gaming, simulation, and modeling packages used in wargaming and force structuring and arms control calculations already available to that group. The latter task involves assessment by the detailed methodology of SIOP and sub-SIOP planning. Because of the unique character of these procedures and the military judgment involved, this effort should be accomplished by JSTPS and the nuclear commanders in chief.

## DEALING WITH LIMITATIONS

Strategic target planning is conducted by the Office of the Joint Chiefs of Staff in response to national policy guidance issued by the President. Thus, when the guidance of PD-59 was issued in July 1980, it essentially formalized a long-developing shift in nuclear policy toward more flexible attack options and was acknowledged as the latest phase in the slow and deliberate evolution of doctrine. As Secretary Brown stated,

The fundamental premises of our countervailing strategy are a natural evolution of the conceptual foundations built over the course of a generation by, for example, Secretaries McNamara and Schlesinger, to name only two of my predecessors who have been most identified with development of our nuclear doctrine.<sup>1</sup>

Changes in strategic nuclear policy should, of course, be carefully analyzed before being implemented in operational plans. Although planning for increased flexibility appears straightforward in theory, in practice technical considerations limit the degree of implementation. Dealing with these limitations requires careful study and takes time, as Secretary Brown noted:

Implementing our strategy requires us to make some changes in our operational planning, such as gradually increasing the scope, variety, and flexibility of options open to us should the Soviets choose aggression. Some of this has already been done since 1977. More needs to be done.<sup>2</sup>



No reason exists for achieving some immediate, dramatic change in strategic targeting capability. The trend in the measures of strategic balance is alarming, but there is no evidence of a critical, irreversible weakness in the US deterrence posture. Any rush to fill a perceived gap in strategic capability runs the risk of reinforcing that perception and, thereby, creating a real political liability. Additionally, ill-conceived, hastily implemented plans to introduce more flexibility could easily erode the deterrence posture.

However, there is an urgent need to assure that policy formulation and strategic target planning procedures do not limit the attainment of the goals of the countervailing strategy. The urgency stems from a concern that nuclear policy decisions may not reflect a complete understanding of the gap between theory and practice in strategic target planning. As Secretary Brown pointed out, policy formulation must be carefully thought out to assure that proposed changes will enhance rather than erode deterrence:

Fashioning strategic nuclear policy that will lead us away from nuclear war and not toward it requires dispassionate analysis, balanced judgments, and a firm grasp of the complexities of the nuclear age.<sup>3</sup>

The immediate task is not to force more flexibility into strategic targeting, but to assure that policy formulation and planning procedures have properly bridged the gap between theory and practice. To this end, consider the following proposed recommendations as goals to be achieved.

#### **CONSIDER LIMITATIONS IN DEVELOPING CONCEPTS**

Policymakers responsible for developing and refining strategy should be aware of the basic limitations in strategic target planning. Strategy designed in ignorance of real limitations is likely to fail. Practical considerations not properly accounted for in planning could prevent a limited, selective attack from meeting its objective. In turn, this failure could cause an unwanted response or preclude subsequent options.

### **OBTAIN FORCE MULTIPLICATION FROM ENHANCED C<sup>3</sup>I**

The nuclear policy implemented in PD-59 requires a survivable, enduring strategic force. However, emphasizing flexibility in strategic targeting is costly and complex. Smaller and more numerous attack options degrade the synergism of the triad, weaken the integrity of the remaining force structure, and lower the confidence associated with the large number of sorties involved in major attack options. The key element in the strategic force must be a system of hardened C<sup>3</sup>I facilities that can provide a lasting battle management function. A system capable of reacting to strategic warning with rapid retargeting could provide the force multiplication needed to permit increased flexibility without excessive increases in the size of the strategic arsenal.

### **RESOLVE TARGET INTELLIGENCE SHORTFALLS**

Resources must be dedicated to the collection and analysis of intelligence required for the narrower targeting objectives associated with increased flexibility. Limited targeting objectives require the identification of separable (in the context of a nuclear attack) entities in the target system and the specification of their functional interrelationship. The current target system may force the planner either to accept token coverage of a particular system or forgo that selected targeting option. It is necessary to assure that such choices are not caused by shortfalls which could be resolved if adequate resources were applied.

### **CHARTER A DOD COORDINATION COMMITTEE**

The OSD should charter a special coordination committee to handle new targeting initiatives. The committee, under DOD control, should be an open forum with wide representation from all Government agencies concerned with national securi-

ty policy. A procedure should be established for the committee to follow in carrying out its evaluation of new concepts. That procedure should assure that each new concept is thoroughly examined in all modes of strategic analysis and at all levels of attacks.

### **TARGET PLANNING IN PERSPECTIVE**

The foregoing recommendations focus upon strategic target planning in general and the SIOP in particular. In a large part these proposed improvements are fostered by the concern that any new targeting concept must, above all, enhance and not erode deterrence. Changes in strategic target planning intended to provide more warfighting capability may be destabilizing, particularly if they appear to be sudden and dramatic revisions in nuclear doctrine.

New concepts in targeting should not outstrip the target system intelligence available or exceed the weapon systems capability. If either the weapon arsenal or target base is lacking, a concept should be revised or delayed until the technological barriers or intelligence shortfalls are removed. In any case, modifications in strategic targeting plans should proceed at a slow and deliberate pace.

However, the recommendations are based upon the presumption that the gap between theory and practice has not been properly bridged. It may well be that the basic limitations have indeed been adequately considered by policymakers. It may also be unnecessary to establish a procedure for developing and reviewing new targeting concepts. The current mechanism employed by the Office of the Secretary of Defense and of the Joint Chiefs of Staff may be adequate. It may be that force modernization and weapon acquisition programs are currently designed to meet the requirements of the flexible response strategy.

Even if the gap is considered to be bridged, the recommendations serve as a reasonable set of measures for the current approach. How are new targeting initiatives identified,

assimilated, and evaluated for implementation? Have any technological barriers or intelligence shortfalls been identified? If so, has action been initiated to resolve them; are the targeting concepts affected by barriers or shortfalls being withheld from implementation?

The recommendations have not been made in an attempt to "stonewall" the SIOP against flexibility. The assured destruction of a strategic attack may be the bedrock of deterrence, but it certainly is not the "end all" or "be all" answer to national security. Flexible attack options are needed and will be provided by responsible, determined planning. But that planning must proceed with care to assure that nuclear forces are capable of carrying out intended attacks if necessary.

Finally, consider this point. The SIOP and any other plan, in and of themselves, do not deter the Soviet Union or any other potential enemy. What does deter is what the enemy thinks our existing weapon systems would do to an actual target system. No matter how cleverly the SIOP or any other plan is designed, it can do no more than convince us that we have an adequate measure of deterrence.

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## GLOSSARY

*Assured destruction.* The ability to inflict unacceptable damage on a particular aggressor or combination of aggressors, even after absorbing a surprise first strike.

*Central war.* A form of general nuclear war in which opposing great powers concentrate their attacks on each other's homeland.

*Collateral casualties and damage.* Physical harm done to persons and property collocated with or adjacent to targets. Collateral effects may or may not be desirable, depending on circumstances.

*Counter control.* The concepts, plans, weapons, and actions used to destroy or neutralize the political and military leadership of the enemy and to disrupt or degrade the enemy's influence with its allies.

*Counter system.* The concepts, plans, weapons, and actions used to destroy or neutralize all segments of the enemy's target system.

*Counterforce.* The concepts, plans, weapons, and actions used to destroy or neutralize selected military capabilities of an enemy.

*Countervalue.* The concepts, plans, weapons, and actions used to destroy or neutralize selected enemy population centers, industries, resources, and/or institutions.

*Cross-targeting.* Attack-planning tactic of assigning warheads carried by different delivery vehicles to the same target.

*Damage limitation.* Active and/or passive efforts to restrict the level or areal extent of devastation during war. Includes counterforce operations of all kinds, as well as civil defense.

*Deterrence.* Measures to prevent, rather than prosecute, wars, using psychological, as opposed to physical, means. Deterrent capabilities reinforce defense, and vice versa.

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*Sources:* John M. Collins, *Grand Strategy: Principles and Peacetime* (Naval Institute Press, Annapolis, 1973), pp. 263-282, and Colin S. Gray, "The Future of Land-Based Missile Forces," *Adelphi Papers* No. 140 (1978), p. iii.

*Equivalent megatonnage.* A measure of the surface damage (by blast) that a nuclear force could inflict, expressed in terms of "one megaton equivalents." Damage from a nuclear explosion diminishes from the point on the earth's surface closest to the explosion as a function of the cube root of the yield of the warhead.  $EMT = NY^{2/3}$  where N is the number of warheads and Y their yields [expressed in megatons].

*Escalation.* An increase in the scope or intensity of a conflict. The increase may be deliberate or unpremeditated.

*First strike.* The initial offensive move of a war. When applied to general war, it implies the ability to eliminate effective retaliation.

*Flexible response.* A strategy predicated on capabilities to act effectively across the entire spectrum of war at times, places, and in manners of the user's choosing.

*General war.* Widespread armed conflict between major powers in which the national survival of one or more belligerents is in jeopardy. The term commonly connotes a global showdown between the United States and the Soviet Union, featuring strategic nuclear weapons and/or other mass casualty producers.

*Limited strategic war.* A form of general war in which one or more belligerents exercise voluntary restraints to restrict casualties and/or damage.

*Massive retaliation.* The act of countering aggression of any type with tremendous destructive power; particularly a crushing nuclear response to any provocation deemed serious enough to warrant military action.

*Second strike.* The first counteroffensive move of a war. When applied to general war, the term implies the ability to survive a surprise first strike and retaliate effectively.

*Triad.* The tripartite US strategic retaliatory force, which comprises manned bombers, intercontinental ballistic missiles, and ballistic-missile submarines.

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